Social Capital and Health: A Study of Adult Twins in the U.S

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A Study of Adult Twins in the U.S.

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Background: A growing number of studies have suggested a link between social capital and health. However, the association may reflect confounding by factors, such as personality or early childhood environment, that are unmeasured prior common causes of both social capital and health outcomes. The purpose of this study was to investigate the impact of social capital on physical and mental health among adult twins in the U.S.

Methods: A cross-sectional national survey of twins within the National Survey of Midlife Development in the U.S. (MIDUS), 1995–1996 was analyzed in 2007. The study population included 944 twin pairs (37.2% monozygotic [MZ] and 62.8% dizygotic [DZ]). Data were obtained on individual-level social capital variables (social trust, sense of belonging, volunteer activity, and community participation); health outcomes (perceived physical and mental health, depressive symptoms and major depression); and individual covariates (age, gender, race, education, working status, and marital status). A fixed-effects model was used to examine health status among twin pairs who were discordant on levels of social capital.

Results: In the individual data analysis, social trust, sense of belonging, and community participation were each significantly associated with health outcomes. In the fixed-effects model, physical health remained significantly positively associated with social trust among MZ and DZ twins. However, major depression was not associated with social capital.

Conclusions: The present study is the first to find the independent positive effect of social trust on self-rated physical health using fixed-effects models of twin data. The results suggest that the association between social capital and physical health status is not explained by unobserved confounds, such as personality or early childhood environment.
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Introduction

Social capital refers to resources accessed by individuals and groups within a social structure that facilitate cooperation, collective action, and the maintenance of norms.[1–3] In health research, social capital has been measured by indicators such as levels of interpersonal trust, the presence of reciprocal exchanges between citizens, and membership in civic organizations.[4]

Social capital can be further conceptualized as both a community- as well as an individual-level attribute.[1] In the latter, studies have characterized individuals as being able to access either higher or lower levels of social capital based on reports of the communities in which they reside, for example, whether there is a high level of trust and reciprocity among residents within the neighborhood. In turn, a growing number of empirical studies have suggested that individual social capital is linked to a range of health outcomes, including self-rated physical health,[2–10] mental health,[5,8,11–16] and health behaviors.[17,18] However, these studies of individual social capital perceptions and health outcomes have a number of methodologic problems. For example, when perceived physical health is used as the outcome, both the exposure variable (e.g., levels of trust within the neighborhood) and the outcome variable are self-reported, thus raising the possibility of common method bias. Common method bias occurs when personality characteristics, such as negative affectivity, influences both social capital perceptions as well as perceptions of health status. In addition the association between social capital and health outcomes may be confounded by other unmeasured common prior causes, such as adverse childhood circumstances, as well as possible genetic factors (e.g., a personality trait that predisposes an individual to being hostile, mistrusting, and unhealthy).

Studying twins provides a unique opportunity to isolate the effect of social capital from these unmea-

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sured common prior causes (confounds). Twins share not only genetic and perinatal factors, but often also their family environment during childhood. Thus, studying twins discordant for social capital offers a unique opportunity to determine whether the association between social capital and health outcomes is consistent after cancelling some unknown predisposing factors. No previous study has investigated the association of social capital and health using twin data.

The National Survey of Midlife Development in the U.S. (MIDUS) in 1995–1996 contains twin data, which provides individual-level social capital perceptions, health outcomes, and individual covariate data. The current study hypothesized that differences in individually-assessed social capital influences the health of twins sharing the same genetic constitution and family environment. The MIDUS twin data were used to elucidate the impact of individual-level social capital on health among twin pairs, monozygotic (MZ) and dizygotic (DZ), who shared the same family environment in childhood.

See related Commentary by Diez Roux in this issue.

Methods

Study Population

Details of sampling procedures have been explained elsewhere.[19] Twin pairs were recruited by using a separate two-part sampling design. The first part involved screening a representative national sample of approximately 50,000 households for the presence of a twin. The screening was conducted by International Communications Research, the market research group of AUS Consultants and Bruskin Associates. Respondents who indicated the presence of twins in the household or being part of a twin pair themselves were asked permission to be contacted by a research team for inclusion in the first national study of twins. The presence of a twin in the family was reported by 14.8% of the respondents, of whom 60.0% gave permission to be contacted for the twin study. The second part of the twin sample design was carried out by interview staff at the Institute for Social Research (the University of Michigan) who contacted the twin households in order to recruit twins to participate in the survey. The cooperating twins were asked to provide contact information for their co-twins. Almost half (49%) of the first contacts identified twin pairs who did not meet the eligibility criteria of the study (aged between 25 and 74 years, non-institutionalized, living in the continental U.S., and speaking English). The final response rate for complete twin interviews was 26%. The final response rate for the twin pairs varied according to whether the first contact was with a relative of the twin (20% response rate) or the twin himself or herself (60% response rate). The final **twin** sample included a total of 1996 twins, resulting in 998 pairs.

Since an interest of the study was in genetic factors of twins, twins in which zygotic status was unknown (n=32; 16 pairs) were excluded; additionally, with the study focus on those who lived together during childhood, if at least one of the pair of twins reported that they had lived separately before aged 14 years, they were excluded from study sample (n=76; 38 twin pairs in which zygotic status is known). The final **study** sample included 1888 individuals, or 944 twin pairs—351 pairs of MZ (37.2%) and 593 pairs of DZ twins (62.8%).

Measurements

Twin pairs were interviewed by telephone questionnaire, which asked about health outcomes and individual covariates, followed by a self-administered mail questionnaire, which included social capital items. The telephone interview was completed by 924 twin pairs (92.6%) and the self-administered mail questionnaire was completed by 807 twin pairs (80.9%).

Perceived physical health was assessed using a single question: *In general, would you say your physical health is . . . .* with Likert-scale responses ranging from *poor, fair, good, very good,* or *excellent.* Perceived mental health was also assessed using a single question: *What about your mental or emotional health?* with Likert-scale responses range from *poor, fair, good, very good,* or *excellent.* The responses *poor* and *fair* were collapsed a priori into a single category, since the lowest category (poor) by itself was too small to allow meaningful statistical analysis (0.9%). To assess major depression, the Composite International Diagnostic Interview Short Form (CIDI-SF), which diagnoses major depression based on DSM-III-R, was used. A diagnosis of major depression requires a period of at least 2 weeks during the past 12 months of either depressed mood or anhedonia most of the day, nearly every day, and a series of at least four other associated symptoms typically found to accompany depression. The assessed depressive symptoms are: (1) lack of interest in most things, (2) feeling more tired or having lower energy than usual, (3) loss of appetite, (4) sleeping difficulties, (5) difficulty concentrating, (6) feeling down, bad, or worthless, and (7) increased thoughts of death. The test–retest reliability and clinical validity of CIDI-SF diagnoses have previously been examined and found to be high,[20, 21] even administered by telephone.[22] The total number of depressive symptoms was also examined as an additional mental health outcome.

Individual perceptions of community social capital were assessed within both cognitive and structural domains. Cognitive social capital indicators included social trust and sense of belonging. Social trust was assessed with a single item: *People in my neighbourhood trust each other. . .* with Likert-scale responses ranging from *not at all, a little, some,* and *a lot.* The responses *not at all* and *a little* were collapsed a priori in order to create three categories, as the *not at all* group was too small (3.2%) by itself to permit further statistical analysis: high trust (37.3%), middle trust (42.3%), and low trust (20.4%). Sense of belonging was a three-item scale derived as the weighted average of responses to the following items: (1) *I don't feel I belong to anything I'd call a community,* (2) *I feel close to other people in my community,* and (3) *My community is a source of comfort.* Responses to each question were recorded on a 7-point Likert scale, with higher scores denoting a higher sense of belonging. As the sense of belonging index was relatively normally distributed, it was analyzed as tertiles (high, medium, and low). The internal consistency reliability of the sense of belonging index was acceptable (Cronbach's α 0.73).

Structural social capital was assessed through inquiry about amounts of volunteer work and community participation.

Volunteer work was calculated as the sum of reported hours per month in volunteer work at a hospital, nursing home, or other health-related settings; school or other youth-related activities; political organizations or causes; and/or any other local organizations or charity. Based on the distribution of responses, volunteer work was categorized into three groups: no volunteer work, 1–9 hours per month, and ≥10 hours per month. Finally, community participation was calculated as the sum of reported frequency of participation per month in religious services, meetings of religious groups, meetings of unions or other professional groups, meetings of sports or social groups, or meetings of any other groups (not including those required by the respondent's job). Based on the distribution of responses, community participation was categorized into four groups: no participation, 1–3 times per month, 4–7 times per month, and ≥8 times per month.

Analysis

First, all twin pairs were treated as individuals and the association between social capital variables and continuous health outcomes was investigated using a generalized estimating equation (GEE) model, which adjusts for the clustering of outcomes within twin pairs. Individual covariates (age, gender, race, education, working status, and marital status) were also adjusted. Details of individual covariates are presented in Table 1.

Second, relationships between social capital indicators and health outcomes were re-analyzed by using fixed-effects model among twin pairs. See Greene[23] and Hsiao[24] for a detailed description of the statistical approach used in the fixed-effects model. Briefly, in the fixed-effects model, the effect of social capital on health outcomes was calculated by cancelling the effect of unknown shared factors, such as genetic or early family environmental influences which might affect health outcomes. An equation representing the association between health and social capital for each pair of twins (let the first subscript, i, represent the twin pair, and let the second subscript represent either twin 1 or 2 in the pair) can be written as follows:

$$y_{i1} = \beta_{11}x_{i1} + \beta_2 d_{i1} + \beta_3 w_{i1} + \beta_4 m_{i1} + \beta_5 s_{i1} + g_{i1} + f_i + \varepsilon_{i1}$$

$$y_{i2} = \beta_{12}x_{i2} + \beta_2 d_{i2} + \beta_3 w_{i2} + \beta_4 m_{i2} + \beta_5 s_{i2} + g_{i2} + f_i + \varepsilon_{i2}$$

where

y is health outcome,

x is the social capital indicator,

d is education, w is working status,

m is marital status,

s is sex,

g and f respectively represent unmeasured factors such as genetic endowment g and early family environment f, and

ε represents a normal error term.

In the fixed-effects model, the effects of these unmeasured factors (i.e., fixed effect) can be cancelled by subtracting the equations as follows:

$$\begin{aligned} y_{i1} - y_{i2} = {} & \beta'_1(x_{i1} - x_{i2}) + \beta'_2(d_{i1} - d_{i2}) + \beta'_3(w_{i1} - w_{i2}) \\ & + \beta'_4(m_{i1} - m_{i2}) + \beta'_5(s_{i1} - s_{i2}) + (g_{i1} - g_{i2}) \\ & + (f_i - f_i) + (\varepsilon_{i1} - \varepsilon_{i2}), \end{aligned}$$

which can be rewritten as:

$$y_i^* = \beta'_1 x_i^* + \beta'_2 d_i^* + \beta'_3 w_i^* + \beta'_4 m_i^* + \beta'_5 s_i^* + g_i^* + f_i^* + \varepsilon_i^*$$

Table 1. Demographic and health characteristics of sample (n=1888)

	Monozygotic (n=702)		Dizygotic (n=1186)	
Variables	**N* or mean**	**% or SD**	**N* or mean**	**% or SD**
Gender				
Male	336	47.9	522	44.1
Female	366	52.1	662	55.9
Age (years)	44.3	11.8	45.3	12.1
Race				
White	594	94.3	951	94.2
Black	25	4.0	41	4.1
Other	11	1.8	18	1.8
Education				
< High school	42	6.2	146	13.0
High school	218	31.9	350	31.2
Some college	229	33.5	329	29.3
Graduated college or more	194	28.4	298	26.5
Working status				
Full-time working	513	75.3	807	72.3
Retired	61	9.0	109	9.8
Homemaker	70	10.3	118	10.6
Unemployment	37	5.4	82	7.4
Marital status				
Married	510	74.6	823	73.2
Separated	14	2.1	27	2.4
Divorced	71	10.4	123	10.9
Widowed	22	3.2	35	3.1
Never married	67	9.8	116	10.3
Perceived physical health				
Poor	6	0.9	34	3.0
Fair	58	8.5	108	9.6
Good	204	29.9	358	31.9
Very good	267	39.1	429	38.2
Excellent	148	21.7	193	17.2
Perceived mental health				
Poor/fair	34	5.0	75	6.7
Good	177	25.9	342	30.4
Very good	259	37.9	389	34.6
Excellent	213	31.2	318	28.3
Major depression (yes)	84	12.0	145	12.2

where the asterisk indicates the difference of variables within each twin pair. As early family environment is the same in both monozygotic and dizygotic twins, f_i^* is equal to zero. In monozygotic twins, the genetic endowment is the same; hence, g_i^* is equal to zero. For monozygotic twins and same-sex dizygotic twins, s_i^* is equal to zero. A p-value <0.05 was considered significant. All analyses were performed by Stata SE version 9.0 in 2007.

Results

Table 1 describes the demographic and health characteristics of the sample according to MZ and DZ status. Overall, the majority of the sample was white, high school graduate or higher, full-time worker, and married. With regard to health status, 9.4% of MZ and

Table 2. The association between continuous health measurements and social capital variables among individual sample (n=1888)

	Perceived physical health		Perceived mental health		Number of depressive symptoms	
	β	**95% CI**	**β**	**95% CI**	**β**	**95% CI**
Social trust	**0.182**	**0.121, 0.243**	**0.187**	**0.129, 0.245**	**−0.239**	**−0.364, −0.115**
Sense of belonging	**0.140**	**0.080, 0.199**	**0.194**	**0.138, 0.250**	**−0.278**	**−0.397, −0.159**
Volunteer activity	0.030	−0.027, 0.087	0.025	−0.029, 0.080	−0.033	−0.149, 0.082
Community participation	**0.044**	**0.005, 0.083**	0.034	−0.003, 0.071	**−0.107**	**−0.186, −0.027**

Perceived physical and mental health was modeled as linear variable, with higher scores indicating better health.
All results were adjusted for gender, age, race, education, working status, and marital status.
Generalized estimating equation model was used to adjust within twin pair correlation.
Bold values significance level $p<0.05$

12.6% of DZ twins reported their perceived physical health as poor or fair, while 5.0% of MZ and 6.7% of DZ twins reported their mental health as poor or fair. Twelve percent of MZ and 12.2% of DZ twins met the criteria for a major depression diagnosis, respectively.

Table 2 shows the association between social capital measurements and continuous health outcomes analyzing the sample as individuals using the GEE model. Cognitive social capital indicators (i.e., social trust and sense of belonging) were significantly associated with perceived physical and mental health as well as number of depressive symptoms in a protective direction even after adjusting for individual covariates (age, gender, race, education, working status, and marital status) as well as the clustering within twin pairs. By contrast, among structural social capital variables, only community participation was significantly associated with perceived physical health and number of depressive symptoms in a protective direction.

Table 3 shows the results of fixed-effects models of social capital indicators on the health outcomes. In MZ twins, social trust was significantly positively associated with perceived physical health after differencing out unknown predisposing factors shared within twin pairs, such as genetic and early family environment (β=0.183, 95% CI=0.038, 0.327). In DZ twins, the association was also significant (β=0.148, 95% CI=0.027, 0.270). However, none of the remaining indicators of social capital (sense of belonging, volunteer activity, or community participation) were associated with perceived physical health among MZ or DZ twins.

With regard to perceived mental health, among DZ twins, a significant association was found between sense of

Table 3. The fixed effects of social capital on health among monozygotic and dizygotic twin pairs

Health outcomes	Social capital measurements	Monozygotic (total pair of n=351)		Dizygotic (total pair of n=593)	
		β	**95% CI**	**β**	**95% CI**
Perceived physical health	Social trust	**0.183**	**0.038, 0.327**	**0.148**	**0.027, 0.270**
	Sense of belonging	−0.042	−0.197, 0.113	0.021	−0.101, 0.142
	Volunteer activity	−0.125	−0.142, 0.117	0.002	−0.108, 0.111
	Community participation	−0.054	−0.148, 0.039	0.052	−0.030, 0.134
Perceived mental health	Social trust	0.071	−0.062, 2.05	0.104*	−0.015, 0.222
	Sense of belonging	0.021	−0.120, 0.163	**0.148**	**0.034, 0.261**
	Volunteer activity	0.037	−0.082, 0.155	−0.015	−0.121, 0.091
	Community participation	0.027	−0.059, 0.112	0.042	−0.037, 0.122
Number of depressive symptoms	Social trust	0.116	−0.176, 0.408	−0.143	−0.380, 0.094
	Sense of belonging	−0.132	−0.449, 0.184	**−0.240**	**−0.476, −0.004**
	Volunteer activity	0.087	−0.178, 0.352	−0.074	−0.288, 0.139
	Community participation	−0.019	−0.209, 0.171	**−0.161**	**−0.321, −0.0004**
		OR	**95% CI**	**OR**	**95% CI**
Major depression	Social trust	1.11	0.58, 2.14	0.78	0.47, 1.28
	Sense of belonging	0.66	0.33, 1.31	0.68	0.41, 1.14
	Volunteer activity	1.32	0.60, 2.88	0.86	0.54, 1.37
	Community participation	0.77	0.45, 1.30	0.76	0.53, 1.09

Perceived physical and mental health was modeled as linear variable, with higher scores indicating better health.
All results were adjusted for gender, education, working status, and marital status.
Bold values significance level $p<0.05$
*p=0.086

belonging (β=0.148, 95% CI=0.034, 0.261), while a marginally significant association was found with social trust ($p<0.1$; β=0.104, 95% CI=−0.015, 0.222). However, no significant association was found among MZ twins. The number of depressive symptoms was significantly associated with sense of belonging and community participation in DZ twins (β=−0.240, 95% CI=−0.476, −0.004; β=−0.161, 95% CI=−0.321, −0.0004, respectively). Similar to perceived mental health, no significant association was found among MZ twins. Major depression was not associated with social capital measurements in either MZ or DZ twins.

Discussion

In this twin study, individual-level social trust perception was found to be associated with better self-rated physical health, even after differencing out the effects of unknown predisposing factors, such as genetic factors or early family environment. Although the coefficient of social trust on self-rated physical health among DZ was smaller than MZ, the difference was not significant ($p>0.3$). This suggests that effects of genetic factors on the association between social trust and self-rated physical health might be small. With regard to mental health outcomes, sense of belonging were positively associated with the single-item mental health measure, while sense of belonging and community participation were negatively associated with number of depressive symptoms, although only among DZ but not among MZ pairs. This suggests that the association between social capital indicators and mental health among DZ twins may be residually confounded by unmeasured genetic factors. For example, there might be some genetic factors which are associated with preference to belong to society and, simultaneously, resilience to stress which result in better mental health. However, major depression, diagnosed as having four or more depressive symptoms, was not associated with social capital in the fixed-effects model.

To the best of our knowledge, the present study is the first to find the independent positive effect of social trust on self-rated physical health using twin data, which enables us to rule out confounding by genetic factors and early family environment. In previous twin studies, it has been reported that genetic factors and shared environment affects the choice of residential location.[25] Therefore, the positive association between social capital and health might be explained by such predisposing factors. For example, unmeasured genetic factors may be related to both better physical health as well as a preference for living in a high social capital community which promotes healthy behaviors or provides emotional support.

Three distinct pathways have been cited for how social capital may promote individual and community health by: (1) promoting healthy norms of behavior, (2) increasing access to local services, and (3) psychosocial process (e.g., access to affective support).[26] Close-knit communities are more effective in disseminating health innovations such as knowledge about health practices. People living in such communities are more likely to heed each other's advice on healthy behavior and to follow norms set by community leaders such as getting regular health check-ups.

In contrast to perceptions of trust, which has been robustly linked to self-rated physical health in previous studies,[27] the empirical evidence linking health to other indicators of social capital such as voluntarism and social participation, has been less consistent. This was true also in the current study (Table 3). The reasons for this discrepancy are not clear. It is possible that there is a degree of reverse causation that may mask the true effects of voluntarism on health; that is, people with pre-existing health problems are more likely to volunteer in certain groups such as self-help groups. Alternatively, social participation may not be health promoting if they impose psychological burdens on participants, as has been reported in some contexts.[9]

In contrast to physical health, the association between social capital and mental health outcomes was not supported by fixed-effects models. The association between social capital and mental health outcomes does not appear to be confounded by early family environment (as suggested by the positive associations among DZ twins, Table 3). On the other hand, the absence of an association among MZ twins suggests some residual confounding by unmeasured genetic traits. However, several limitations should be noted before concluding that social capital does not affect mental health. First, the validity of the single-item self-rated measure of mental health is uncertain, compared to the single-item measure of physical health which has been consistently found to be a predictor of mortality and hospitalization.[28] Although the number of depressive symptoms was used as an additional mental health outcome, further research using established instruments to assess mental health, such as the General Health Questionnaire, are needed to replicate the findings of the present study. Second, the fixed-effects analysis was likely to be statistically under-powered for analyses of major depression. The number of discordant twin pairs with major depression is dramatically lower compared to the sample sizes for analyses using the other health outcomes. Third, cross-sectional design makes it challenging to interpret the long-term impact of social capital on mental health. Some people with mental illness may have selectively moved to secure, trusting communities. This may have contributed to the diluted effect of social capital on mental health in a cross-sectional design. Further longitudinal twin studies would help to solve this limitation.

Additional limitations of this study include the fact that social capital variables were not measured at the community-level due to lack of availability in the MIDUS data set. Current analysis is cross-sectional, so that reverse causation cannot be ruled out. In addition, it was assumed that twins living together to aged 14 years shared the same family environment, but living together in childhood does not necessary mean that they shared the same "rearing" family environment. Nonetheless, fixed-effects models among twins advances the empirical evidence base for social capital by suggesting that the relationship between trust and self-rated physical health is unlikely to be confounded by genetic factors, or early family environment.

Based on these findings, preventive health policies may benefit from a focus on interventions that fosters social trust in the community. Although few demonstrations exist of interventions to build social capital, Putnam[29] among others has suggested several directions for such efforts, including expanded funding for community service programs, and providing incentives to private sector employers to introduce flexible work arrangements that facilitate their employees to "invest" in the social capital of their families and communities. In other words, incorporating social capital in prevention would mean expanding the realm of action from the personal (*What can I do to prevent ill health?*) to the public (*What can the community do to promote health?*), as well as from the health field to the broader set of social determinants of health.

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